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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the ball bearing built into the rotary support part of various rotary machine devices, such as an AC dynamo, a compressor, an electromagnetic clutch device, belt pulley means for supporting, a water pump device, and an electric motor, for example. Especially the ball bearing of this invention can prevent the fall (shortening) of a life, even when it is used under a high velocity revolution and hot environments.
[0002]
[Description of the Prior Art]For example, auxiliary machinery for cars, such as an AC dynamo and a compressor, is rotated with the engine for a run. He builds over an endless belt between the driven pulley provided in the end of the axis of rotation of this auxiliary machinery for cars, and the driving pulley fixed to the end of the crankshaft of the above-mentioned engine for a run, and is trying to rotate the above-mentioned axis of rotation based on circulation of this endless belt for this reason.
[0003]Drawing 2 shows the structure of the rotation portion of the axis of rotation 1 of the compressor which constitutes the conditioner for cars. This axis of rotation 1 is supported in the casing 2 with anti-friction bearing which is not illustrated, enabling free rotation. The driven pulley 4 is supported with the ball bearing 5 around [which was provided in the end outside of this casing 2] the support cylinder part 3, enabling free rotation. This driven pulley 4 constitutes the whole from section KO type in a circle. The solenoid 6 fixed to the end face of the above-mentioned casing 2 is arranged to the building envelope of the above-mentioned driven pulley 4.

[0004]On the other hand, the attaching bracket 7 is fixed to the portion projected from the above-mentioned casing 2 at the end of the above-mentioned axis of rotation 1, and the annular plate 8 made from a magnetic material is supported via the flat spring 9 around this attaching bracket 7. At the time of un-energizing to the above-mentioned solenoid 6, by the elasticity of the above-mentioned flat spring 9, this annular plate 8 is being isolated from the above-mentioned driven pulley 4, as shown in drawing 2, but. At the time of the energization to the above-mentioned solenoid 6, it adsorbs towards this driven pulley 4, and transfer of the torque from this driven pulley 4 to the above-mentioned axis of rotation 1 is enabled.
[0005]By the way, with highly-efficient-izing centering on a high increase in power of the auxiliary machinery for cars in recent years, increasingly, it was accelerating and the service condition of the ball

bearing 5 which constitutes the above rotation supporting devices is carrying out the temperature rise. Also when it is used by such a high speed and high temperature service for this reason, the ball bearing 5 which has the outstanding endurance is called for. And elevated-temperature dimensional stabilization processing (an elevated-temperature annealing process and sub-zero treatment) is performed so that the inner ring 10 which constitutes this ball bearing 5, the outer ring of spiral wound gasket 11, and two or more balls 12 may not carry out a dimensional change under hot environments that such endurance should be secured, Reducing the amount of retained austenites which exists in steel is performed. That is, compared with martensite, reduction of austenite with low yield stress was aimed at, and harmful plastic deformation is made hard to produce, and the temporal dimensional change accompanying martensite-izing (martensitic transformation) of retained austenite, i.e., increase of volume, (expansion) is prevented.

[0006]

[Problem(s) to be Solved by the Invention]However, when performing elevated-temperature dimensional stabilization processing to this appearance, it is not avoided that the manufacturing cost of the ball bearing 5 increases. For this reason, performing elevated-temperature dimensional stabilization processing only to the inner ring 10 which constitutes this ball bearing 5, the outer ring of spiral wound gasket 11, the inner ring 10 of two or more balls 12, and the outer ring of spiral wound gasket 11 in order to attain cheap-ization of the manufacturing cost of this ball bearing 5, and performing the usual heat treatment to each remaining balls 12 is generally performed. However, if the ball bearing 5 which performed the usual heat treatment to each ball 12 is used for this appearance by hot environments, Only each above-mentioned ball 12 which does not perform dimensional stabilization processing may expand temporally, namely, volume may increase with martensite-izing of retained austenite, and the internal gap (a radial gap and an axial gap) of the above-mentioned ball bearing 5 may narrow. And if the internal gap of the ball bearing 5 becomes narrow at this appearance, the contact pressure of the rolling-contact part of the inner race track 13 and the outer race track 14, and each above-mentioned ball 12 will increase. It not only may increase the running torque of the above-mentioned ball bearing 5, but since damage to exfoliation, seizure, etc. is made easy to produce in each above-mentioned ball 12, the inner race track 13, and the outer race track 14, increase of such contact pressure may result in a life at an early stage.

[0007]It is [that increase of the contact pressure of such a rolling-contact part should be prevented] possible to set up greatly the internal gap of the above-mentioned ball bearing 5 by an initial state. However, when the above-mentioned internal gap is greatly set as this appearance by an initial state, depending on condition of use, each above-mentioned ball 12 may become large [the above-mentioned internal gap] with as not expanding as expected (retained austenite does not martensite-ize). As a result, the load added to each above-mentioned ball 12 becomes uneven, the rotational accuracy of the above-mentioned ball bearing 5 falls, and vibration of this ball bearing 5 may increase and the life of this ball bearing 5 may fall. On the other hand, when each above-mentioned ball 12 expanded beyond anticipation, or when the above-mentioned internal gap cannot fully be secured, the contact pressure of a rolling-contact part increases as mentioned above, and a life falls.

[0008]Since increase of the volume accompanied by such expansion, i.e., martensite-izing of retained austenite, changes the variation (expanding quantity) according to external factors, such as service temperature and an operating speed, even if it maintains highly the inside dimension of the above-mentioned ball bearing 5, it is difficult increase to fully prevent the above inconvenience. If this ball

bearing 5 is used under hot environments, since retained austenite will martensite-ize at an early stage, the inconvenience by the above dimensional changes may arise notably. This invention is invented in view of such a situation that the fall of the life of a ball bearing based on martensite-izing of retained austenite should be prevented.

[0009]

[Means for Solving the Problem]A ball bearing of this invention is provided with the following.

A steel inner ring of spiral wound gasket which has an inner race track in a peripheral face like a ball bearing widely known from the former.

A steel outer ring of spiral wound gasket which has an outer race track in inner skin.

Two or more balls which were provided between these inner race tracks and an outer race track enabling free rolling and whose each is steel.

In a ball bearing of this invention, especially irrespective of temporal expansion accompanying martensite-izing of retained austenite of the above-mentioned inner ring, an outer ring of spiral wound gasket, and each ball, The amount of retained austenites of which member is regulated at least on the basis of expanding quantity based on the amount of retained austenites of other members the above-mentioned inner ring, an outer ring of spiral wound gasket, and of each ball in order to maintain an internal gap at a proper value. For example, each makes the amount of retained austenites of each ball of inner rings and outer rings of spiral wound gasket which are the products made from bearing steel whose each the amount of retained austenites of an outer ring of spiral wound gasket is made into 6 - 12 capacity % at least, and is similarly a product made from bearing steel 4 - 10 capacity %. And the above-mentioned amount of retained austenites is more preferably regulated further on the basis of service temperature of a ball bearing.

[0010]

[Function]Since according to the ball bearing of this invention constituted as mentioned above the expanding quantity of which member of these each member is regulated even if an inner ring, an outer ring of spiral wound gasket, and each ball expand temporally with martensite-izing of retained austenite, an internal gap can be maintained at an always proper size. In other words, this crevice can be prevented from the above-mentioned internal gap becoming narrow too much, and it being sufficient, or becoming large with as by expanding each above-mentioned member with sufficient balance. For this reason, the contact pressure of a rolling-contact part with each above-mentioned ball, an inner race track, and an outer race track can prevent becoming excessive or causing fall of rotational accuracy, and increase of vibration. As a result, even when continuing and using it for a long time by a high temperature state, the life of the above-mentioned ball bearing can be prevented from falling.

[0011]

[Embodiment of the Invention]Drawing 1 shows one example of an embodiment of the invention. The inner ring of spiral wound gasket 10 made from bearing steel which has the deep groove type inner race track 13 in a peripheral face like the ball bearing widely known from the former as for the ball bearing 5a of this invention, It has two or more balls 12 which were provided between the outer ring of spiral wound gasket 11 made from bearing steel which has the deep groove type outer race track 14 in inner skin, and these inner race tracks 13 and the outer race track 14 enabling free rolling and whose each is the products made from bearing steel. The ball 12 of these plurality is held with the cage 15, enabling free rolling, and has plugged up the both-ends opening of the annular space 16 between the peripheral face of the above-mentioned inner ring 10, and the inner skin of the above-mentioned outer ring of spiral

wound gasket 11 with the seal plates 17 and 17, respectively.
[0012]Especially, in the ball bearing 5a of this invention, even if the above-mentioned inner ring 10, the outer ring of spiral wound gasket 11, and each ball 12 expand temporally with martensite-izing of retained austenite, It has regulated on the basis of the above-mentioned inner ring 10, the outer ring of spiral wound gasket 11, and the expanding quantity based on [at least] the amount of retained austenites of other members for the amount of retained austenites of which member of each ball 12 so that the internal gap (a radial gap and an axial gap) of this ball bearing 5a can be maintained at a proper value. Namely, in this example, inside [each is the inner ring 10 and the outer ring of spiral wound gasket 11 which were built by SUJ2 (JIS G 4805) which are two sorts of high-carbon-chromium bearing steel] makes the amount of retained austenites of the outer ring of spiral wound gasket 11 at least 6 - 12 capacity %, and. Similarly each makes the amount of retained austenites of each ball 12 which is a product made from bearing steel (SUJ2) 4 - 10 capacity %. Thus, the reason for increasing the amount of retained austenites of the outer ring of spiral wound gasket 11 compared with the amount of retained austenites of each above-mentioned ball 12 is for absorbing expansion of each above-mentioned ball 12 and the inner ring 10 by expansion of this outer ring of spiral wound gasket 11, i.e., increase of the inside diameter of this outer ring of spiral wound gasket. In order to regulate the amount of retained austenites of the outer ring of spiral wound gasket 11 (and inner ring 10) or each ball 12 to a desired value as mentioned above, quench-and-temper temperature and the temperature of sub-zero treatment adjust. When the service temperature of the above-mentioned ball bearing 5a is decided beforehand, the amount of retained austenites of each above-mentioned members 10, 11, and 12 may be further regulated on the basis of this service temperature.
[0013]According to this invention constituted as mentioned above, since the outer ring of spiral wound gasket 11 of these and the expanding quantity of each ball 12 are regulated even if the inner ring 10, the outer ring of spiral wound gasket 11, and each ball 12 expand temporally with martensite-izing of retained austenite, the internal gap of the above-mentioned ball bearing 5a can be maintained at an always proper size. That is, it enables it to absorb an expanded part of the above-mentioned inner ring 10 and the outer diameter of each ball 12 according to increase of the inside diameter accompanying expansion of the above-mentioned outer ring of spiral wound gasket 11. In other words, this crevice is prevented from the above-mentioned internal gap becoming narrow too much, and it being sufficient, or becoming large with as by expanding each above-mentioned members 10, 11, and 12 with sufficient balance. For this reason, the contact pressure of a rolling-contact part with each above-mentioned ball 12, the inner race track 13, and the outer race track 14 can prevent becoming excessive or causing fall of rotational accuracy, and increase of vibration. As a result, also when it is used for a long period of time by a high temperature state, having continued, the life of the above-mentioned ball bearing 5a can be prevented from falling. When the amount of retained austenites is further regulated on the basis of the service temperature of the above-mentioned ball bearing 5a, the inconvenience by change of the above-mentioned internal gap can be prevented more by Hajime Takatsugi.
[0014]When the amount of retained austenites of the above-mentioned outer ring of spiral wound gasket 11 is less than 6 capacity %, or when the amount of retained austenites of each above-mentioned ball 12 is less than 4 capacity %, the work for reducing this amount of retained austenites, i.e., heat treatment, and sub-zero treatment become troublesome, and it is not avoided that a manufacturing cost increases. And when the above-mentioned outer ring of spiral wound gasket 11 is less than 6 capacity %, there is too little expanding quantity of this outer ring of spiral wound gasket 11 to absorb an expanded part of

the above-mentioned inner ring 10 and the outer diameter of each ball 12. On the other hand, when the amount of retained austenites of the above-mentioned outer ring of spiral wound gasket 11 exceeds 12 capacity %, or when the amount of retained austenites of each above-mentioned ball 12 exceeds 10 capacity %, there are too many these amounts of retained austenites, and it becomes difficult to secure the hardness of these each members 11 and 12. And with use, each above-mentioned members 11 and 12 will expand greatly, the pressure of a rolling-contact part may increase or a fitting surface with the member which carries out inner fitting of the above-mentioned outer ring of spiral wound gasket 11 and this outer ring of spiral wound gasket 11 may be damaged. Especially concerning the amount of retained austenites of the above-mentioned inner ring of spiral wound gasket 10, it is not necessary to regulate in order to secure an internal gap. Among these this reason is based on expansion of the above-mentioned inner ring 10, the amount of increases of the outer diameter of the ring 10 is because it is small compared with the amount of increases of the inside diameter of the above-mentioned outer ring of spiral wound gasket 11. However, in order to secure fitting strength with the member which attaches this inner ring of spiral wound gasket 10 outside, for example in order to secure the hardness of this inner ring of spiral wound gasket 10, it is preferred to regulate the amount of retained austenites of this inner ring of spiral wound gasket 10.

[0015]Although above-mentioned explanation was performed about the case where it is the inner ring 10, the outer ring of spiral wound gasket 11, and bearing steel made from high-carbon-chromium bearing steel (SUJ2) with each common ball 12, i.e., a product, it is not limited only to this. For example, in the case of the inner ring 10 made from bearing steel (SUJ2) and the outer ring of spiral wound gasket 11 which did 1 capacity % addition of silicon (Si), the amount of retained austenites is regulated as follows. First, as for the above-mentioned inner ring of spiral wound gasket 10, below 3 capacity % carries out the amount of retained austenites with elevated-temperature hardening tempering temperature. The above-mentioned outer ring of spiral wound gasket 11 makes the amount of retained austenites 6 - 12 capacity % by adjusting hardening tempering temperature. Each ball 12 makes the amount of retained austenites 4 to 10% by performing standard heat treatment mentioned above. Thus, an internal gap can be maintained at a proper value, also when regulating the amount of retained austenites and the above-mentioned inner ring 10, the outer ring of spiral wound gasket 11, and each ball 12 expand temporally with martensite-izing of retained austenite. And since below 3 capacity % is carrying out the amount of retained austenites of the above-mentioned inner ring of spiral wound gasket 10, the expanding quantity of this inner ring of spiral wound gasket 10 can be stopped few, and it becomes easy to secure fitting strength with the member which attached this inner ring of spiral wound gasket 10 and this inner ring of spiral wound gasket 10 outside.

[0016]

[Effect of the Invention]Since the ball bearing of this invention is constituted and acts as it was stated above, also when it is used by hot environments, it can secure sufficient endurance. As a result, the auxiliary machinery for cars can be contributed to highly efficient-ization centering on a high increase in power of various mechanical apparatus made into the start.

[Translation done.]